EXHIBIT A
SCOPE OF SERVICES
FOR
LIFT STATION ASSESSMENT AND PRIORITIZATION FOR REHABILITATION
DATED: AUGUST 1, 2011

PROJECT BACKGROUND, PURPOSE AND SCOPE OVERVIEW

The City of Durham's Department of Water Management (City) operates and maintains 62 wastewater lift station facilities (including seven Master Lift Stations) and approximately 90 miles of force mains within the limits of their wastewater collection system. Brown and Caldwell (Engineer) was selected to assist the City in implementing a capital and Operations and Maintenance (O&M) improvement program for their lift stations. Design capacities of the lift stations range from as little as 24 gpm to approximately 11,000 gpm. The City's initial goal for this project is to develop a prioritized list of repair/refurbishment projects based upon a comprehensive condition assessment and criticality analysis of lift stations planned to remain in operation. In addition, the City wishes to advance lift stations design standards, develop an Arc Flash program for their stations with 480 volt electric service and design replacement/refurbishment improvements for five existing lift stations.

This project is divided into five (5) Phases:

- Phase 1 – Lift Station Condition Assessment and Capital Improvement Prioritization
- Phase 2 –Operation and Maintenance (O&M) Procedures Update
- Phase 3 – Lift Station Design Standard Development
- Phase 4 – Arc-Flash Study
- Phase 5 – Parkwood Lift Station Evaluation

Phases may be performed concurrently.

DETAILED SCOPE OF SERVICES

Phase 1 – Lift Station Condition Assessment and Capital Improvement Prioritization

Each lift station asset will first be evaluated in terms of its physical condition and operating performance. That assessment and other inputs by City staff will be used to determine the likelihood and consequence of failure (or criticality) for each lift station. Engineer will develop planning estimates of the costs to repair lift station deficiencies observed, and will develop a defensible prioritization of repairs.

Task 1: Mobilization and Project Management. Upon issuance of Notice to Proceed, Engineer will develop a health and safety plan, review available information provided by the City, tailor the assessment forms, and develop field assessment work plan.

1.1. Develop Heath and Safety Plan**.** Engineer will prepare a Health and Safety Plan, including a list of Engineer project personnel responsible for health and safety, hazard analysis for the anticipated activities, required personal protective equipment, contingency measures and forms. Field personnel will be briefed on the plan.

1.2. Review Available Information. Engineer will request information from the City which is required to complete the lift station assessment and prioritization activities, and will coordinate with the City to obtain this information. The data request is expected to include, at a minimum:

- Record drawings for each lift station
- Pump curves and other pump, motor and standby generator record data
- Lift station operation and maintenance manuals
- GIS files including planimetric data and sanitary sewer data
- Operation and maintenance data including pump run (hours) data
- Maintenance records
- Sanitary sewer overflow (SSO) records of lift station-related spills

Engineer will allocate up to three days for interviews with appropriate City staff to become familiar with the City's wastewater lift station system and to obtain input on the proposed assessment work plan.

Engineer will arrange to make scanned copies of record drawings and other key record information of each lift station. Electronic copies of the record information will be made available to the City.

City staff will develop a list of lift stations in order of priority to be assessed by Engineer. Engineer anticipates that if the requested information is not available by two weeks prior to the planned start of field condition assessment activities, lift station data will be provided for the highest-priority lift stations first.

1.3. Develop Lift Station Condition Assessment Forms. Engineer will develop condition assessment forms, which will be used by Engineer's field assessment teams to record information relating to lift station assets and record the condition of assets at stations where field condition assessments are performed. The forms will be in a Microsoft Access database format. The assessment forms will incorporate Engineer's recommendation relating to pump station design standardization.

At the beginning of this task, a meeting will be held with City staff to review and agree upon the content for the condition assessment forms, proposed condition and performance rankings, and criticality matrices. Engineer will submit draft condition assessment forms to City staff for review, and will produce final condition assessment forms based on City input.

Engineer anticipates that forms will include asset classes illustrated in Table 1.
Engineer will interview City operating staff regarding operability and observed deficiencies at each of the lift stations to be assessed. Engineer will note City staff comments about observed deficiencies or problems anticipated to be encountered during assessment activities. Engineer will communicate results of interviews to City's project manager and to field assessment teams.

City responsibilities include:

- Participate in meeting to review and provide input on condition assessment forms and condition and performance ranking criteria
- Provide input on Access database and future compatibility with the City's computerized maintenance management system (CMMS)

Table 1. Anticipated Lift Station Condition Assessment Elements

Lift Station Asset Class	Assessment Elements
Site Improvements	Assess condition of fencing, landscaping/aesthetics, driving surfaces (potholes, gravel coverage, and driveway cracks), and sidewalks.
Structures (including wet and dry wells)	Exterior/interior areas of pumping facility buildings will be assessed for noticeable deficiencies. Dry wells will be assessed for visual evidence of spalling, loose shaft carrier brackets, crossbeam support degradation, and other visual deficiencies. Sump pumps and emergency shut-off buttons will be checked for operability. General housekeeping and health and safety issues will be documented.
HVAC	HVAC units will be assessed visually for operability, vibrations, and corrosion. Ducts and louvers will be inspected for leakage and proper operation.
Electrical Systems	Electrical deficiencies will be recorded, including dust in control panel, dry or cracked cables, blackening of copper, and loosened electrical contacts.
Generator	In cases where an emergency generator is located on site, City O&M personnel will shut off building power and start the unit to allow Engineer to perform assessment. Where connections for a portable generator are not provided, connections will be assessed based on condition only and no performance tests will be conducted.
Instrumentation	Bubblers, compressors, RTUs, and floats will be checked for operability and performance issues.
Monitoring/Alarms	Monitoring and alarms through autodialers at each site will be visually assessed; data transmission performance will be supplied by City O&M personnel.
VFD	VFD panels will be assessed in the same manner as electrical panels.
Pump Motors	Individual pump motors will be assessed for abnormal noise, excessive heat, obvious vibration, and any visual deficiencies (e.g., cracked casing). Utilization determined using pump run time logs.
Horizontal & Vertical Pumps	Pumps will be assessed for issues including overly-tight or loose packing, vibration, cavitations, bearing noise, shaft vibration or deflection, U-joint issues, and excessive noise. Pump mountings and bases will be checked for loose mounts or cracking.
Submersible Pumps	Individual motors will not be visually assessed. The operability of the pumps will be assessed.
Piping & Valves	The suction isolation valve, discharge isolation valve, and check valve for each pump will be assessed, noting malfunctioning or leaking. With pumps in the "Off" position, under the direction of City O&M personnel will verify that valves are operable.
Odor Control and Noise	Discussions with City staff to identify stations where odor or noise problems have been reported, and assess on an as-needed basis. Identification of alternates for odor and noise control, including non-chemical treatment options.
Replacement Parts	For critical pump stations, assessment of recommended replacement parts for City to keep on-hand for critical equipment

1.4 Project Management. Engineer will schedule a project chartering meeting with City staff within 14 days of the notice to proceed. At this meeting, Engineer will review the project

scope and schedule, clarify Client-Consultant project team communications, and confirm City's goals for the project and critical success factors.

Engineer will submit a draft project management plan (PMP) for review and input from City staff. The PMP will outline responsibilities, lines of communication, accounting, and other critical management information. It will also discuss specific procedures to maintain the project schedule and budget, including estimation of percent complete compared to budget expended based on attainment of project milestones.

Engineer will facilitate a monthly progress meeting with the City's project manager. These meetings will review project progress, discuss upcoming tasks, and compare schedule and budget against the PMP.

Engineer will maintain project schedule updates in Primavera, will provide reports to City at the monthly progress meeting.

Task 2: Condition Assessment of Lift Stations. Engineer will perform condition assessments for the 57 wastewater lift stations listed in Table 2, in accordance with the procedures stated in the following subtasks. Seven other City lift stations not included in Table 2 will not be assessed; for example, the City may plan to remove a lift station from service in the near future.

Engineer will utilize two assessment teams for evaluation of small lift stations, each operating concurrently, and an additional assessment team for the seven Master Lift Stations,: Eno, Lick Creek, Stagecoach, Heritage Drive, Glenn Road #1, Cooksbury, and Fletcher Chapel Rd.

Table 2. City of Durham Wastewater Lift Stations to be Assessed, in Lift Station Number Order

#000 - Herndon Park	#116 - Southpoint Plantation	#201 - Bren Rose	#218 - Rose of Sharon
#100 - Garrett Road	#117 - Stage Rd.	#202 - Cedar Creek	#219 - Snow Hill Road
#101 - Celeste Circle	#118 - Stagecoach	#203 - Cooksbury	#220 - Sparger Rd.
#102 - Downing Creek	#120 - Vesson	#204 - Dearborn Dr.	#222 - Treyburn #2
#103 - East End	#121 - Downing Woods	#205 - Leigh Farm	#223 - Treyburn #3
#104 - Falconbridge	#122 - Elmset	#207 - Glenn Road #1	#226 - Treyburn #4
#105 - Fletcher Chapel Rd	#123 - Solterra	#208 - Glenn Road #2	#227 - November Dr.
#106 - Frazier Forest	#124 - Newhall 6023	#209 - Guess Rd. #1	#228 - Guess Road #2
#107 - Eagle View	#125 - Parkwood	#210 - Heritage Dr.	#229 - Glenview
#108 - Geer St.	#126 - Audubon Park	#211 - Landis Dr.	#303 - Fayetteville Rd.
#109 - Githens School	#127 - Continental Dr.	#213 - Lutravil	#901 - Eno
#110 - Hickory Nut Dr.	#128 - Rondelay	#214 - Northgate South	#902 - Lick Creek
#111 - Highway 70	#129 - Brightleaf at the Park	#215 - Treyburn #1	
#114 - Massey Chapel	#130 - Tract 8	#216 - Plantation Dr.	
#115 - Glenda Road	#200 - Marywood	#217 - Rivermont	

2.1. Dry Well Condition Assessment Procedure

- Engineer will perform an appropriate safety briefing for its staff prior to each site visit.
- Engineer will photograph each lift station to capture the site layout, building elevations and potential issues which have been observed.

- Engineer will perform visual assessment for each lift station inspected, in accordance with the elements in Table 1 for each asset group. For visual inspections of lift stations which are defined as confined-space entry or permit-required confined space entry, Engineer will use appropriate personal protective equipment (PPE) provided by the Engineer, and ensure that entry into the confined space is in accordance with the Health and Safety plan.
- Based on visual assessments, Engineer will provide a condition score for concrete vault and steel vault structures. For structures with significant visible degradation, Engineer will identify appropriate additional testing to evaluate the structural integrity of the concrete vaults and steel vaults; recommended structural integrity testing would be performed as an additional service by amendment to this scope of services.
- Engineer's inspection teams will complete condition assessment forms for each lift station inspected, recording descriptive information and condition assessment for lift station assets.
- In the event of missing name plate data, Engineer will review record information collected during Task 1 as a post-condition assessment activity. If data was not provided in Task 1, Engineer will attempt to obtain missing data needed for the condition assessment by contacting equipment manufacturers.
- Engineer will recommend methods for ongoing assessment of steel pump station structures by City staff to screen structures for detailed assessment.

City responsibilities include:

- Provide access to each lift station for Engineer staff. Engineer's lift station inspection teams will require support from two City O&M staff, approximately one day per week. This support will entail running pumps, drawing down the level in the wet well and opening electrical panels. Other meetings and workshops requiring City staff participation are identified in the scope of services. For lift stations which are defined as confined-space entry, or permit-required confined space entry, City will provide appropriate personal-protective equipment, gas monitors and other set up required for entry. At the beginning of the project, City staff will provide Engineer a list of confined-space entry and permit-required confined-space entry lift stations.
- Accompany Engineer during each lift station assessment, and assist Engineer with activities performed during the assessment, including opening electrical panels, guards, or hatches for Engineer to evaluate electrical components, operating lift station pumps in manual mode to permit verification of pump operability, and similar activities. City's O&M personnel will return lift station to automatic operation at the conclusion of each assessment. City will also shut off HVAC and lights and properly secure lift station doors and gates.

2.2. Wet Well Condition Assessment Procedure

- Engineer will perform a multi-gas detection test on the unopened wet well by inserting the gas detector hose into the wet well hatch hole to measure air quality. The presence of hydrogen sulfide will be checked as a potential indicator of a corrosive environment.

After recording gas concentration, Engineer will request City staff to turn on the wet well HVAC and open hatches. Engineer staff will not perform a permit confined-space entry into wet wells.

- Once the hatch is open, fall prevention devices provided by the Engineer will be placed over the hatch opening and a quick review of the wet well will be performed to determine the optimal locations for power washing, pH testing, and scratch testing.
- The water level in the wet well will be lowered by starting the pumps. The pump's vent line operation will also be monitored during lowering of the water level.
- A pH test will be performed under the top slab and on a high and low portion of the wet well wall.
- A vertical area along one side of the wet well wall will be washed using a power washer (provided by the City) and a scratch test will be performed on concrete wet well walls. Tests will be performed with the aid of a pole-mounted device and observed by a pole-mounted camera; Engineer staff will not perform a permit confined-space entry into wet wells to conduct scratch tests. Scratch tests will not be performed on steel wet wells.
- Condition of the wet well walls, slabs, piping, valves, floats, ladders and rails will be visually inspected using a pole camera. Digital photographs or video will be collected.
- Measurements will be taken of the wet well to determine dimensions and operating levels: Low, Lead On, Lag On, High, and other alarm levels. Engineer will use a laser measuring tape and leveling rod to make measurements. This information will be required for determining available wet well capacity and for lift station drawdown tests.
- Based on visual assessments, Engineer will provide a condition score for wet well structures. For structures with significant visible degradation, Engineer will identify appropriate additional testing to evaluate the structural integrity; recommended structural integrity testing would be performed as an additional service by amendment to this scope of services.

City responsibilities include:

- Providing access to lift stations for Engineer staff
- Opening electrical panels, guards, or hatches for Engineer to visually evaluate electrical components
- Operating lift station electrical system (i.e. turning the power off/on to the pumps). This will include drawing down the level of the pumps to allow Engineer to take measurements of the operating levels.
- Performing pressure washing of an area along one site of wet-well walls to ensure degreased prior to assessment.

2.3. Drawdown Testing Procedure

- Engineer will perform pump drawdown tests over an approximate seven-day period for each lift station. The drawdown testing will be used to determine the flow characteristics of each lift station, as well as to diagnose potential problems.
- Engineer will provide and install an Isco 4501 Pump Station Flow Monitor (Flow Monitors) in order to perform a seven-day pump drawdown test. City O&M staff will assist with connecting the Flow Monitor to the lift station's existing electrical system using current clamps. Engineer staff will prepare Flow Monitor for data logging and will reset equipment prior to each drawdown test.
- The Flow Monitor will log start and stop times of pumps at the lift station as the wet well fills and is emptied. Pump activity data will be stored on the Flow Monitor and data will be analyzed using Isco Pumplink™ software. Combining data logged by the Flow Monitor with known volumes between level switches in the wet well, an algorithm provided with the Pumplink™ software is used to calculate flow into and out of the lift station for each pump.

  The Flow Monitor unit will be used to determine:

  - Total and average inflow
  - Minimum and maximum inflow and times of occurrence
  - Inflow and outflow for each fill and empty cycle
  - Number of starts for each pump
  - Average pumping rate for each pump
  - Data on combinations on pumps

  Seven or more cycles of filling and pumping are necessary to analyze the filling and pumping of the lift station using the flow monitor. To ensure adequate data is collected for analysis using Isco Pumplink™ software algorithms, seven days will normally be allotted for monitoring. In addition to determining pump performance, the Flow Monitor may also assist with identifying lift station performance issues, including alternator failures or chattering relays.
- Upon the completion of flow monitoring, Engineer will collect and analyze data. Engineer will evaluate wet well storage capacity and number of pump starts observed during flow monitoring, and compare with normal pump station operation.

City responsibilities include:

- Operating lift station electrical system (i.e. turn power off/on to lift station pumps)
- Connecting Flow Monitor to 110V power socket on panel and utilize current clamps provided with the Flow Monitor to connect it with the pump motor starters.
- At end of monitoring period, remove current clamps and remove Flow Monitor.

2.4. Condition and Performance Rankings. After completion of on-site assessment of each lift station facility, Engineer will assign a score ranging from 1 to 5 for each asset using the Condition and Performance (C&P) Ranking criteria below:

- Condition Ranking

  1-Excellent
  2-Slightly Visible Degradation
  3-Visible Degradation
  4-Integrity of Component Moderately Compromised
  5-Integrity of Component Severely Compromised

- Performance Ranking

  1-Component Functioning as Intended
  2-In-Service, but Higher than Expected O&M
  3-In-Service, but Function is Impaired
  4-In-Service, but Function is Highly Impaired
  5-Component not Functioning as Intended

These Condition and Performance (C&P) rankings will be categorized into five regions corresponding with the urgency for rehabilitation, as detailed below. Engineer will use the C&P rankings for the lift station facilities to develop a program of rehabilitation and/or O&M activities to mitigate these risks. The recommended actions corresponding to the regions will be used as a guide for further action.

Region 1 - Good Condition and Performance. The assets with low C&P ranking scores of 1 or 2 will be in this category. Recommended action for these types of assets will be "No immediate action required" as no failure is expected for assets categorized in this region.

Region 2 - Moderate Condition and Performance. The assets with at least one moderate ranking score of 3 will be in this category. Recommended action for these types of assets will be "Initiate More Detailed Inspection" in order to determine the potential risks for failure.

Region 3 - Poor Condition Ranking. The assets with poor condition ranking scores of 4 or 5, but which are performing well (performance ranking scores of 1, 2, or 3) will be in this category. Recommended action for these types of assets will be "Schedule Corrective Action Work Order for Near Term". Although the assets are in service and functioning, issues related to the condition of these assets should be addressed.

Region 4 - Poor Performance Ranking. The assets with poor performance ranking scores of 4 or 5, but with condition ranking scores of 1, 2, or 3 will be in this category. Recommended action for these types of assets is "Immediate Corrective Action Required" as the asset is not functioning properly, or failure is imminent.

Region 5 – Poor Condition and Performance. The assets with poor condition and poor performance scores of 4 or 5 will be in this category. Recommended action for these types of assets will be "Replace / Refurbish" as the asset is not functioning properly and the integrity of its components are either moderately or severely compromised.

2.5. Workshop to Evaluate Force Main Condition Assessment Options. Engineer will facilitate a collaborative 2-hour workshop for City's Department of Water Management Engineering staff outlining the range of options for performing force main condition assessment. Engineer's senior technologist will describe technologies and discuss pros and cons of the options relative to the City's wastewater force mains.

Following the workshop, Engineer will prepare a brief memorandum (approximately 4 pages) summarizing force main condition assessment technologies, cost, and applicability. Based on the information provided by City staff at the workshop, the memorandum will include a preliminary recommendation of the force main condition assessment technologies most appropriate for the City's wastewater force mains.

Engineer anticipates the Town of Cary will be conducting force main condition assessments during the time this project is ongoing. Engineer will attempt to arrange a site visit for City personnel to observe the Town of Cary force main condition assessment operations.

2.6. Preparation of Technical Memoranda for Lift Stations. Engineer will provide a technical memorandum (TM) for the each of the City's 57 lift stations to be evaluated, approximately 3 weeks after the completion of field assessment activities. The TMs will report findings of the condition assessment and drawdown testing for that station. The TM will include the following information:

- Details of when condition assessment was performed
- Map showing the location of the lift station evaluated
- General site information and layout
- Tabulated inventory of key pump and motor asset data
- Results of condition and performance rankings by asset type and class. Tables will classify condition and performance assets by the regions identified in Task 2.4.
- Summary of observed deficiencies and further recommended actions
- Summary of drawdown test results showing the firm capacity of lift station, individual pump capacities, inflow in period and estimated utilization
- Review of emergency response characteristics in terms of wet well capacity, emergency storage in pipes and bypass pumping arrangements
- Check for general conformance with NFPA 820, OSHA, and DENR regulations
- Pump drawdown test analysis:
    - Influent hydrographs showing daily and hourly flow patterns
    - Number of pump starts versus standard practices for normal operation
    - Estimated capacity of pumps operating individually, or in combinations of two or more running concurrently
    - Determine current utilization of available firm capacity
    - List of problems requiring further investigation
    - Comparison with pump curves to evaluate current duty point and operating condition

- Notation of hydraulic, mechanical, electrical or hydraulic problems that have been identified during the field condition assessment. TM will include recommended further actions which could be taken to address identified deficiencies.
- Comparison of anticipated lift station firm capacity with current flows, and the station's ability to accommodate future increased flows. Engineer does not anticipate master-planning analysis of future/buildout service area flows.
- Recommendation of measures City could implement to standardize the existing lift stations around certain equipment, based on input from City maintenance staff.
- Appendix with condition assessment forms and site photos
- A CD containing the electronic files of record information including record drawings, pump curves, cut sheets and other key record data will be submitted with the TMs

Engineer will meet with City staff to discuss assessment work findings and receive comments on draft TMs. Following receipt of comments, Engineer will finalize the TMs.

City responsibilities include review and comment on draft lift stations TMs.

2.7. Printed and Electronic Deliverables. One complete copy of the pump station assessment reports will be provided, as three volumes of technical memoranda in three-ring binders. Electronic copies of these volumes will also be provided on compact discs. Volumes 1 and 2 will include results of condition assessments performed at City wastewater lift stations. City staff will receive pre-punched copies of the draft technical memoranda for each lift station within 2-3 weeks after the condition assessment, which can then be inserted into the three-ring binders. Engineer will respond to any comments received from City staff on the draft technical memoranda and produce final versions of the technical memoranda; pre-punched for convenience.

Volume 3 will comprise a summary report documenting results of Tasks 3 and 4, and addressing findings of the assessment project, including areas of concern. Specific areas of concern to be addressed are:

- Whether lift station emergency generators appear adequately sized to handle future pumping needs
- Bypass capability for lift stations
- Feasibility and need for measures to alleviate peak flows at wastewater treatment facilities due to peak flows from master lift stations, including flow equalization at master lift stations or wastewater treatment facilities
- For major lift stations, a review of the potential hydraulic capacities of the key components will be undertaken. A table will be included to show the potential hydraulic capacity of components such as the wet well, pumps, suction and delivery pipework, including the force main. The overall potential upgraded capacity of the lift station will be estimated. Comments will be included to note constraints affecting the ability to upgrade the lift station. Recommendations will be given on future upgrade options.

- Whether enhancement of odor control measures is recommended, and options for eliminating existing odor control facilities with changes in operating practices

Preparation of Microsoft Access Database: Engineer will also provide a Microsoft Access database containing lift station assessment data electronically, in a data table format. The database will contain inventory and condition assessment data of assets included in the assessment activities, including photographs, video and flow data collected during condition assessment field activities. This database will be updated after completion of each lift station condition assessment. Database will incorporate geo-referenced lift station locations in the City's Geographic Information System (GIS) format, so that data tables can be accessed through GIS.

City responsibilities include:

- Review draft Lift Station Assessment Report Volumes 1-3
- Review Microsoft Access Database

Task 3: Criticality Assessment. Under this task, Engineer will develop a criticality model in order to assess the criticality of each lift station. The model will be in a Microsoft Excel format and be developed with input from City staff.

The premise for the development of a criticality model is to manage risk, or criticality. Risk will be expressed as a function of the "likelihood" that a lift station asset will fail to meet its level of service requirement and the "consequence" this asset failure would have on the City's level of service:

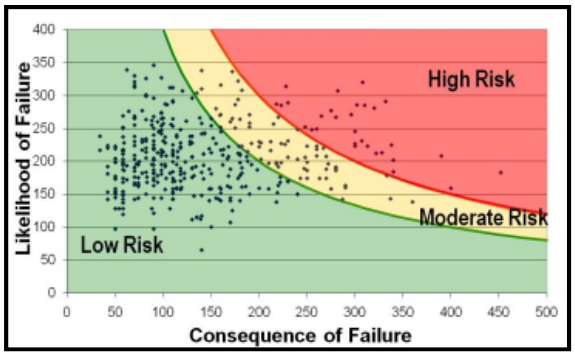
RISK = Likelihood of Failure x Consequence of Failure

The Condition and Performance rankings for each lift station (as determined during the lift station condition assessments in Task 2) will represent the "likelihood of failure" side of the equation.

Engineer will develop "consequence of failure" rankings for each lift station in collaboration with City staff. Each lift station will be assessed a numerical score for several criteria, including key emergency response characteristics such as emergency bypass capabilities, excess wet well capacity response time, and vulnerability to catastrophic failure. Additional consequence of failure criteria that may be considered, based on input from City staff, are: proximity to state waters, design capacity (specific to the master lift stations), level of service requirements, critical customers, upstream tributary lift stations, difficulty to repair, and system-wide impact. Rankings will be assigned in a work-session with City staff based on readily-available information.

Engineer will use the Condition and Performance rankings and the Consequence ranking, to prepare an overall criticality score for each lift station. This score will be the basis for prioritization of rehabilitation projects and operations and maintenance actions at the most critical, highest risk lift stations in Task 4.

Engineer will tabulate criticality assessment findings in an Excel spreadsheet. Lift stations will be ranked in terms of their criticality. Engineer will group lift stations in terms of high risk (red), moderate risk (yellow) and low risk (green). Results will be tabulated and graphed in terms of these classifications, in a manner similar to the example below.



Example Scatter Graph of Criticality Scores
for Lift Station Condition Assessment.

Engineer will not perform a full Failure Modes Evaluation Analysis (FMEA).

City responsibilities include:

- Participate in workshop to develop Consequence of Failure criteria and weightings

Task 4: Determine Costs and Prioritization. Engineer will analyze lift stations criticality assessment findings and develop a list of repairs and operation and maintenance actions in order of priority.

Engineer will develop preliminary planning-level opinions of probable cost for design and construction of recommended lift station repair/refurbishment projects, new or replacement lift stations, and abandonments. Planning-level opinions of probable cost will be based upon recently awarded Contracts in the area, RS Means and other sources. City staff will provide examples of bids for recent City of Durham lift station projects to assist with tailoring cost estimates.

Engineer will present the prioritized list of new construction and rehabilitation projects in a tabular format, including opinions of probable construction, rehabilitation and repair costs. Engineer will present a separate prioritized list of proposed repair work, which can be undertaken by City O&M staff. Engineer will present recommendations as a 20-year capital improvement plan (CIP) which identifies a prioritized plan for lift station rehabilitation and replacement.

Engineer will prepare a Technical Memorandum to describe findings of Tasks 3 and 4.

City responsibilities include:

- Meet with Engineer staff and provide input on format for cost tables
- Review and comment on draft and final TM

<u>Phase 2 - Operation and Maintenance (O&M) Procedures Update</u>

Task 5: Allowance for On-Call O&M Procedures Update Assistance. This task is an allowance for on-call work to be defined by the City for Engineer to assist the City's O&M staff to revise

current wastewater lift station standard operations and maintenance procedures, and develop new procedures as required, into an operations and maintenance manual. The City will authorize Engineer in writing to work under this task, providing specific direction regarding specific scope, schedule and associated fee under this allowance. Amendment to this Agreement is not required in order for the City to authorize work under this task. Work may be performed on a lump sum basis or a time and materials basis, in accordance with the terms of the Agreement.

Specific work under this task has not yet been defined. The general types of work which may be included in this allowance task include:

A. Meetings to interview the City's O&M staff regarding current operating and maintenance procedures relating to wastewater lift stations.

B. Reviewing current wastewater lift station O&M procedures including, but not limited to:

- Operation and maintenance records to determine current hourly, daily, weekly, monthly O&M procedures. This review will address both general procedures as well as procedures relating to individual lift stations.
- Standard operating procedures
- Contingency procedures
- Department succession plan, and related training programs
- Current organization of City O&M personnel
- Gap analysis to determine any deficiencies or areas for improvement

C. Develop preventive maintenance equipment plan for assets included in the proposed CMMS.

D. Revising current wastewater lift station O&M standard operating procedures, and developing new procedures as required, into an operations and maintenance manual. The standard operating procedures may include accompanying operations and maintenance forms.

E. Review the City's existing wastewater lift station emergency operation plan. Comment on the plan's documentation of how the City maintains continuous operability at each station during potential emergency situations that would impact operation.

Task deliverables are anticipated to be technical memoranda and/or O&M procedures, as defined by the City. Specific work tasks and deliverables are expected to be defined by the City following completion of the anticipated CMMS needs assessment by Engineer (authorized separately). Written direction regarding specific scope, schedule and associated fee under this allowance will be provided to Engineer at that time.

City responsibilities include:

- Defining specific work and deliverables required under this allowance task
- Making O&M staff available to be interviewed by Engineer staff to provide input on O&M procedures
- Review and comment on draft and final TMs

Phase 3 – Lift Station Design Standard Development

Task 6: Lift Station Design Standardization and Guidelines. Engineer will review the City of Durham's current Lift Station Design Checklist. Engineer will prepare for and facilitate a workshop with City staff to review the City's objectives for improvement of the City's current Lift Station Design Checklist. During workshop, Engineer will review the lift station design guidelines of two or three similar municipal utilities, and City staff will provide feedback on features of these other approaches which may be desired in the new lift station design standards.

Engineer shall prepare a memorandum documenting recommendations for improvement of the City of Durham's current Lift Station Design Checklist. The objective of this subtask is to provide a standard pump station design that will assist the City as necessary to support the City's growth, lift station replacement and expansion.

Engineer will meet with representatives of the City's Department of Water Management and Department of Public Works, to review the proposed process to formally revise the design checklist and adopt new lift station design standards. Representatives of these departments shall review and provide input on the pump station design standardization memorandum.

Following review and concurrence/modification of the recommendations for new lift station design standards, Engineer will prepare a draft lift station design standard document. City staff shall review the proposed design standard document, and Engineer will participate in a meeting with City staff to review comments and the process for adoption of the new standards. Engineer will revise the document once to incorporate review comments and submit the final proposed design standards document for the City's formal review process. Further revision of the design standards document after initiating the formal review process for adoption may be performed by City staff, or could be revised by Engineer as an amendment to this scope of services.

City responsibilities include:

- Participate in workshop to define City's objectives and structure for new lift station design standards.
- Meet with Engineer and provide input on format for lift station design standards
- Review and comment on draft and final lift station design standards
- Revisions of lift station design standards document required for final adoption

Phase 4 – Arc Flash Assessment Services

Task 7: Arc-Flash Study. Engineer will perform an arc flash study for the 26 wastewater lift stations listed in Table 3, which have 480v, 3 phase power in accordance with the procedures stated in the following subtasks. NFPE 70.E, Article 130.3, Exception 1 states that arc flash hazard analysis is not required where: (1) the circuit is rated 240V or less; (2) the circuit is supplied by 1 transformer; (3) the supply transformer is rated less than 125kVA. Engineer will perform arc flash study field activities in conjunction with the Task 2 lift station condition assessments for these lift stations, utilizing two electrical engineers each operating concurrently. Arc flash study field activities for the Master Lift Stations will be conducted with dedicated site visits.

Table 3. Wastewater Lift Stations with 480v Power, for Arc Flash Study		
#105 - Fletcher Chapel Rd	#130 - Tract 8	#219 - Snow Hill Road
#109 - Githens School	#207 - Glenn Road#1	#222 - Treyburn #2
#111 - Highway 70	#209 - Guess Rd. #1	#223 - Treyburn #3
#114 - Massey Chapel	#210 - Heritage Dr.	#226 - Treyburn #4
#116 - Southpoint Plantation	#211 - Landis Dr.	#229 - Glenview
#117 - Stage Rd.	#213 - Lutravil	#303 - Fayetteville Road
#118 - Stagecoach	#215 - Treyburn #1	#901 - Eno
#128 - Rondelay	#217 - Rivermont	#902 - Lick Creek
#129 - Brightleaf at the Park	#218 - Rose of Sharon	

Engineer will perform an arc flash analysis including, but not limited to the following:

7.1 As-built Documentation Investigation

- Review existing lift station record drawings and as-built documentation as it was provided during field installation.

7.2 Field Investigation

- Visit and conduct field verification of existing electrical distribution system (EDS) including Motor Control Centers, Switchgear, Switchboards, Panelboards, Industrial Control Panels and Transformers larger than 125kVA that are rated as three-phase equipment. 240V and 208V single-phase circuits will not be included. Field verification will be conducted down to 120/240V Panel boards; however panel board branch circuits will not be verified.

The following information will be gathered:

- Power Source Type: Voltage and Ampacity
- Power Source Short Circuit Current Available (as provided by the utility supplier)
- Disconnecting Means: Type, Voltage and Ampacity
- Load Type: Voltage and Ampacity
- Cable Type: Size and Length
- Raceway: Type and Size
- Equipment Labeling: Power Source and Power Load
- Over-current Protection manufacturer and model data including device settings such as manufacturer and model of the circuit breakers and or fuses.

City responsibilities include:

- Provide access to each lift station for Engineer. For lift stations defined as confined-space entry, or permit-required confined space entry, City will provide appropriate personal-protective equipment, gas monitors and other set up required for entry.
- Accompany Engineer during each arc-flash study field investigation, and assist Engineer with activities including opening electrical panels, guards, or hatches for Engineer to

evaluate electrical components and similar activities. City's O&M personnel will return lift station to automatic operation at the conclusion of each assessment.

7.3 Data Analysis

- Conduct Short Circuit and Protective Device Coordination studies. The EDS will be modeled using each of the normal utility and generator sources based on the plant normal operating conditions. Studies will include SKM generated Single Line Diagrams populated with available fault current data, feeder data and protective device data.
- Based on existing conditions, Engineer will document adverse conditions noted during the field investigation phase and include recommended specific corrective actions. Unsafe conditions will be brought to the attention of the City immediately. In addition coordination issues discovered during the studies will be noted with recommended corrective actions.
- An Arc Flash Analysis will be conducted on the existing EDS including Motor Control Centers, Switchgear, Switchboards, Panelboards, Industrial Control Panels and Transformers larger than 125kVA that are rated as three-phase equipment. Equipment below 240/208V three phase will not be verified unless it involves at least one low-impedance transformer in its immediate power supply. The analysis will include the fault currents calculated in the Short Circuit and Protective Device Coordination study. Based on these values Engineer will review the correlation of the following:
  - Arc Thermal Performance Value required at each power circuit node.
  - Protective device time current coordination curves.
  - Relay and circuit breaker trip settings.
  - Fuse selection to provide Arc Flash Protection and maintain system coordination.

7.4 Engineer will forward a draft report to City for review. The report shall include completed analysis for each lift stations. City shall provide comments draft report to Engineer within 3 weeks of receipt. Upon receipt of review comments, Engineer will request a final review workshop. Engineer will provide a final report to the City within three weeks after receipt of City comments on the draft report.

7.5 Create and install arc flash hazard equipment labels

- Engineer will develop the required equipment labels based on Engineer and NFPA-70E standards. The City will be required to purchase the labels directly.
- Engineer will provide personnel to install labels on the appropriate equipment.
- Engineer will allocate one day to attend walk-throughs of a sampling of representative lift stations with designated City staff to review label installation. Any deficiencies that are part of this scope will be noted and corrected by Engineer.

7.6 Training

- Engineer will provide up to two 1-hour arc flash hazard and labeling orientation training to personnel at a location designated by the City. The presentation will focus on understanding the significance of arc flash hazard analysis, arc flash hazard labeling,

understanding information on the label and what it means to City staff. This training will follow the recommendations of NFPA-70E.

City responsibilities include:

- Providing available as-built or record drawings
- Providing access to the lift stations for Engineer staff
- Opening electrical panels, guards, or hatches for Engineer to evaluate electrical components
- De-energizing electrical equipment at the lift stations to facilitate data collection by the Engineer staff.

Phase 5 – Lift Station Improvements Evaluation

Task 8: Parkwood Lift Station Alternatives Evaluation. The City has identified Parkwood Lift Station (LS) as in critical need of rehabilitation, repair and upgrade, to increase the amount of time City staff have to respond to high wet well alarms and address other condition/performance issues. Table 4 summarizes the issues identified with the lift station. An alternatives analysis, or business case evaluation, will be made for Parkwood LS to develop the basis of design for a future project. Design of improvements to the Parkwood LS is not included in this scope of services.

Table 4. Summary of Parkwood LS Identified Problems

Parkwood LS Description	Key Problems
Above-ground suction lift station Two 25 HP, 500 gpm pumps	• Existing pumps cannot pump solids; bar screen must be very well maintained • Inefficient manual bar screen requires high level of maintenance • No bypass screen and limited storage for response time to deal with emergencies (< 20 minutes) • Further development anticipated in service area; firm capacity of pumps may not meet future needs

8.1. Workshop/Group Site Visit. Engineer will facilitate a single four hour-long workshop and site visit with the City's staff to discuss identified deficiencies with Parkwood LS, and define alternatives for improvements to lift station that take into account the following:

- Parkwood LS service area
- City's objectives for improvement of Parkwood LS
- Pumping system (capacity, pump type, wet well, surge mitigation, controls, variable frequency drives, etc)
- Design preferences
- Requirement for on-site solids handling
- Impact to the surrounding community

The workshop will entail an initial session at the City's offices; a visit to Parkwood LS; and a one-hour wrap-up meeting will be held at the City's offices to document field observations and alternatives for analysis.

8.2 Alternatives Analysis. Following the workshop, Engineer will prepare an alternatives analysis for improvements to Parkwood LS, as follows:

- Review historical and current records in order to determine average and peak pump run times for each pump. Review findings from condition assessment for this lift station.
- Coordinate with City staff to obtain wastewater flow information for the service area, if available.
- Obtain Parkwood LS drawings, survey drawings, easement plats and legal descriptions from the City. If adequate as-built and site plan information is not available, Engineer's surveyor will perform limited topographic and boundary survey at the Parkwood LS site sufficient to evaluate alternatives for lift station improvements.
- Evaluate options to improve the screening, or use of comminutors or grinder pumps.
- Evaluate three options to replace the existing lift station and make recommendations, including recommended pump selections. Prepare schematic, not-to-scale drawings to represent each alternative.
- Prepare planning-level, order of magnitude estimate of probable construction cost for most viable option to replace the lift station.

8.3 Study Memorandum. Engineer will prepare a brief technical memorandum to present the findings of the alternative analysis. The memorandum will include the following:

- Summary of field condition assessment observations
- Preliminary design data table
- Diagrams of design alternatives
- Alternatives analysis summary
- Summary outlining site constraints and mechanical, civil, structural, electrical, and instrumentation & control design

Additional Services Requiring Owner's Written Authorization

If authorized in writing by City, Consultant may provide additional services to the City under this agreement, of the types listed below.

- Field condition assessments of other City wastewater lift stations not explicitly identified in this Exhibit.
- Additional testing of concrete or steel vaults at wastewater lift stations to evaluate the structural integrity of the vaults, based on the results of initial field assessment screening.
- Planning and field assessment activities associated with wastewater force mains.

- Meetings, workshops and presentations to City staff or officials, other than those identified in this Exhibit.
- Design-related activities other than those specifically identified in this Exhibit.
- Assistance with permitting-related activities.
- Other related services requested by the City.

ESTIMATED PROJECT SCHEDULE

The projected total project duration for tasks authorized in this Agreement is 12 months, as illustrated in Figure 1.

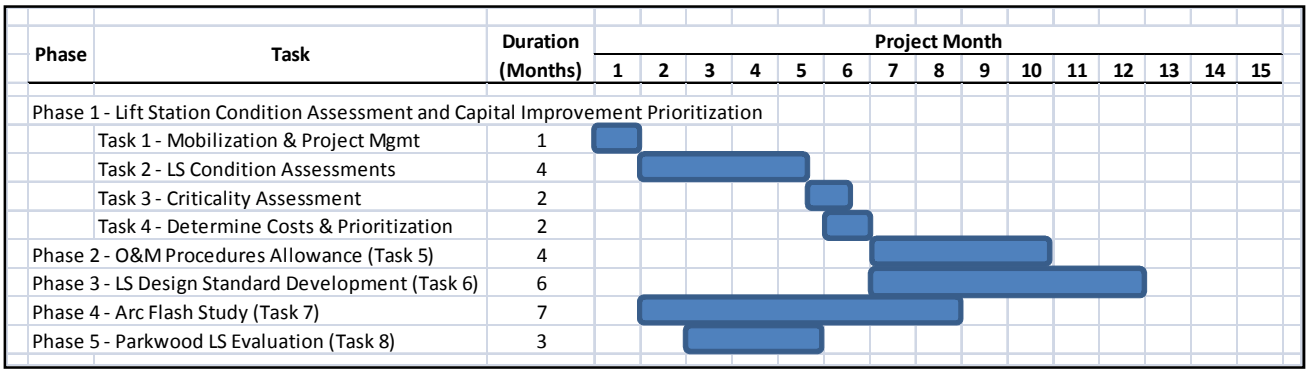


Figure 1 – Project Schedule Overview

For Phase 1 activities (Lift Station Condition Assessment and Capital Improvement Prioritization), Engineer anticipates delivery of the final TM deliverables to the City eight months after the notice to proceed (NTP). Project activities allocated as follows:

- Task 1 - Mobilization and work plan preparation – Month 1

  Task 1 also includes general project management tasks which will be performed throughout the project.

- Task 2 – Field condition assessments of all lift stations – Months 2 to 5. This time-frame is based on assessing four lift stations per week –using four data loggers or flow monitor to perform the pump drawdown tests as outlined in our approach.

  Three weeks is allocated for City review and comment on draft technical memorandum deliverables; the final report deliverables are anticipated to be delivered during Month 7.

  Force main condition assessment options workshop (Task 2.5) may be scheduled at any time throughout the project – at the City's convenience; field visits to example force main condition assessment will be planned during the performance of Town of Cary field activities in Summer/Fall 2011.

- Tasks 3 and 4 – Lift Station Criticality Assessment and Capital Improvement Prioritization will be performed during Months 5 and 6.

Phase 2 (Update of Lift Station O&M Procedures) and Phase 3 (Lift Station Design Standard Development) activities will commence following conclusion of Phase 1 activities, approximately 7 months after NTP. Phase 2 activities will be completed over an approximate 4 month duration; Phase 3 activities are estimated to require a 6-month duration, though this may be extended at the City's option depending on internal City processes for modification of lift station design standards.

Phase 4 (Arc-Flash Study) field activities will be delivered in conjunction with the lift station assessments, in Months 2 to 5, with draft and final reports delivered during Months 6 through 8.

Phase 5 activities (Parkwood Lift Station Evaluation) will be initiated in Month 3, and the study memorandum will be delivered in Month 5.

Three weeks are allocated in the schedule for review of each draft assessment report and other deliverables identified in the scope of services; a longer review schedule is allocated for the operations and maintenance manual and the revised wastewater pump station design standards.